HEALTH INSURANCE AND PRODUCTIVITY:

EVIDENCE FROM THE MANUFACTURING SECTOR

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Abstract

This paper examines the relationship between employer-sponsored offers of health insurance and establishments' labor productivity. Our empirical work is based on unique plant level data that links the 1997 and 2002 Medical Expenditure Panel Survey-Insurance Component with the 1992, 1997, and 2002 Census of Manufactures. These linked data provide information on employer-provided insurance and productivity. We find that health insurance offers are positively associated with levels of establishments' labor productivity. These findings hold for all manufacturers as well as those with fewer than 100 employees. Our preliminary results also show a drop in health care costs from the 75th to the 25th percentile would increase the probability of a plant offering insurance by 1.5-2.0 percent in both 1997 and 2002. The results from this paper provide encouraging and new empirical evidence on the benefits employers may reap by offering health insurance to workers.

Keywords: Employer-provided health insurance; labor productivity; manufacturing industries.

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1. Introduction

We are all too familiar with statistics on the millions of uninsured individuals in the United States, a situation exacerbated by rising health care costs. Since employers are the primary source of private health insurance, the search for public policy solutions turns to the employer-sponsored health insurance (ESI) system. But the percent of businesses offering ESI is not encouraging. Although the percent of establishments offering health insurance increased from 52.4 to 59.3 percent in 1997 and 2000, since then offer rates have been steadily decreasing, reaching 55.8 percent in 2006.[1] Offer rates among smaller employers exhibited a similar pattern but the decline has been more dramatic in recent years. An understanding of employers' incentives for providing health insurance to workers is important for reform initiatives. While the literature studying why employers offer health insurance is large, the goal of this paper is to provide new empirical evidence on the benefits employers may reap by offering this benefit.

The reasons employers offer health insurance include attracting and retaining skilled workers and maintaining a healthier workforce that may be more productive.[2] Employers who include health insurance in their compensation package can also experience cost advantages. That is, the tax treatment for offering insurance can result in compensation packages that include this benefit to actually cost the employer less than paying wages alone.[3]

[1] Agency for Healthcare Research and Quality. *Percent of private-sector establishments that offer health insurance by firm size and selected characteristics* (Table I.A.2), years 1996-2006: 1996 (Revised March 2000), 1997 (March 2000), 1998 (August 2000), 1999 (August 2001), 2000 (August 2002), 2001 (August 2003), 2002 (July 2004), 2003 (July 2005), 2004 (July 2006), 2005 (July 2007), 2006 (July 2008). Medical Expenditure Panel Survey Insurance Component Tables. Generated using MEPSnet/IC. <http://www.meps.ahrq.gov/mepsnet/IC/MEPSnetIC.jsp> (May 02, 2009)

[2] See O'Brien (2003) for a discussion on employers' benefits from offering ESI.

[3] Employer's cost for health insurance is exempt from federal and state income taxes, as well as taxes for Social Security and Medicare. See Selden and Gray (2006).

While employers have incentives for offering ESI, workers also have reasons for preferring coverage through their employer versus other sources.[4] Economic theory posits (Summers 1989; Pauly 1997) and some empirical studies show that the value workers' place on ESI can lead them to pay for this benefit through reduced wages.[5] In contrast, the business community contends employers pay the full cost of offering ESI and cannot afford the increase in premiums associated with increasing health care costs. Despite this contention, many businesses have increased employee cost sharing for ESI to help control rising costs. Sommers (2005) addresses these paradoxes and adds a nominal wage constraint to the traditional model of ESI. Using data from the Current Population Survey he shows nominal wage stickiness may help explain these paradoxes.

In this paper we study these contradictory views of economists and business owners from a different perspective. If wages cannot be reduced to fully offset the employer's cost of health insurance, why would the employer continue offering this benefit? Do offers of ESI improve productivity in the form of increased revenue, thereby providing businesses with a reason to offer insurance? Buchmueller (2000) provides a summary of studies looking at how health insurance may indirectly improve productivity and concludes that the findings overall do not suggest a business case for ESI.[6] To date, no studies have studied this relationship using a direct

[4] The alternative source of private coverage for workers would be purchasing insurance in the individual market. However, without the lower costs associated with economies of scale and reduced issues of adverse risk selection in the employer's group market, the cost to individuals can be prohibitively high. In addition, employers often set up arrangements so that employee contributions towards the cost of premiums are made on a pretax basis and this financial benefit to the employee increases with their marginal tax rate.

[5] The goal of this paper is to show whether or not employers reap some benefits from offering health insurance in the form of greater productivity, and not to address compensating differentials involving wages and health insurance offers. For discussions on compensating differentials see Hwang et al. (1992), Currie and Madrian (1999), and Royalty (2008).

[6] If employers believe that offering health insurance to workers will be more profitable than offering wages alone, that is, providing insurance improves the company's bottom line, this has been refered to as the business case for employers to offer health insurance (Buchmueller 2000; O'Brien 2003).

measure of productivity while also addressing the endogeneity associated with the employer's offer of health insurance.

Since access to data measuring revenue and productivity is limited, very few studies have looked at the relationship between health insurance offers and productivity.[7] This paper uses a unique and confidential dataset of manufacturing establishments to examine this relationship using a two-stage regression analysis. We link data from the 1997 and 2002 Medical Expenditure Panel Survey-Insurance Component (MEPS-IC) and the 1997 and 2002 Census of Manufactures (CMF) to look at employers of all sizes within the manufacturing sector.[8] In addition, since small employers are less likely to offer health insurance, we examine whether a business case might be argued for these employers.[9] Data from the manufacturing sector allow us to study the relationship between health insurance and labor productivity by providing information on plant productivity, health insurance offers, and the quality of labor.

Our results show a positive relationship between employer offers of health insurance and labor productivity in 1997 and 2002.[10] In analyses of small establishments with less than 100 employees, we also find a positive relationship between offers and productivity in both years. Our preliminary results also show a drop in health care costs from the 75th to the 25th percentile would increase the probability of a plant offering insurance by 1.5-2.0 percent in both 1997 and

[7] If health insurance improves worker health and that improved health increases productivity, then ceteris paribus, a positive relationship between health insurance offers and productivity would be seen. Studies on the impact of health insurance on health are summarized by McWilliams (2009), Levy and Meltzer (2001, 2008) and Hadley (2003). See O'Brien (2003), Hadley (2003), Davis et al. (2005), Wojcik (2007), and Freeman et al. (2008) for discussions on the relationship between health and productivity.

[8] We focus on plants in manufacturing because the data for this industrial sector include productivity measures.

[9] For more information on small employers and health insurance offerings, see Feldman et al. (1997), Nichols et al. (1997), Gabel et al. (1999), Hadley and Reschovsky (2002), Nichols (2005), Gencarelli (2005), Zawacki and Taylor (2005), Blumberg (2007), Econometrica (2007), and Baicker and Dow (2008).

[10] In the cross section, we expect to see more productive workers earning higher wages and being offered health insurance. While attempts are made in the models to control for worker quality and skill, the authors acknowledge it is difficult to distinguish between increases in productivity resulting from unmeasured aspects of labor quality and direct ways in which health insurance may increase productivity.

2002. The empirical findings from our research are encouraging and suggest employers may reap benefits from offering health insurance to workers.

2. Background

Most of the information available on the relationship between health insurance and productivity has come from surveys where researchers asked employers why they offer insurance and also asked about the influence of insurance on employee performance and productivity. Whitmore et al. (2006) [11] find that 78 percent of firms believe that health insurance is somewhat or very important for improving employees' performance. Fronstin et al. (2003) report that among employers, 28 percent report that a major reason and 36 percent a minor reason for their offering insurance is that it increases productivity by keeping employees healthy.

To the best of our knowledge, Decressin et al. (2009) is the only empirical study that examines the direct relationship between firm performance and employer offers of health insurance. The authors combine information on the characteristics of firms and workers with administrative benefit data, but caution that health coverage is understated in their data.[12] They examine the relationship between offering a health plan and performance using a relative labor productivity measure based on sales per employee. They find that offering a health plan is positively correlated with productivity, although the relationship is not significant for the manufacturing sample. They also find a positive relationship between health insurance offers

[11] Commonwealth Fund supplement to the Henry J. Kaiser Family Foundation/Health Research and Educational Trust Survey of Employer-sponsored Health Benefits, 2006.
[12] Based on their comparison of benefit coverage rates from national survey estimates with estimates from their matched data.

and the failure of the firm.[13] Since the study does not address the endogeneity of benefit offerings, causality is not being examined.

Poor health status resulting from the lack of health insurance can potentially reduce productivity. The question is: Does health insurance improve health status?[14] Levy and Meltzer (2001, 2008) summarize the results from the RAND experimental study and natural experiments addressing this question.[15] RAND's social experiment randomly assigned health insurance with different levels of generosity to individuals and health outcomes were compared across groups. Improved health was seen for those with poor vision or high blood pressure in the group with more generous insurance coverage. Based on their review of natural experiments that had been conducted, the authors conclude that expansions of health coverage generally result in improved health. McWilliams (2009), Freeman et al. (2008), and Hadley (2003) also conclude that support exists for showing health insurance improves health.[16]

Health insurance may indirectly provide benefits to the employer. These benefits might include reduced employee turnover, absenteeism, or workmen's compensation costs and/or improved employee health or morale. Studies on health insurance reducing turnover (Garrett and Chernew 2008; Dey and Flinn 2005; Buchmueller 2000), absenteeism (Gilleskie 1998; Vistnes 1997; Newhouse 1993), and workmen's compensation claims (Lakdawalla et al. 2007; Card and McCall 1996) provide mixed results.

[13] Failure is indicated when the firm no longer files unemployment insurance records.

[14] Studies addressing this question are complicated by the endogeneity of health insurance. That is, some factors affecting coverage can also affect health status, and health status in turn may also affect insurance coverage. In addition, unobserved differences such as culture, environment, and attitudes may affect health status and health insurance coverage at the same time. Finally, insurance coverage has been shown to lead to more utilization of medical care, but increased medical care has not always shown to be better.

[15] The authors also review observational studies, however, these are not considered reliable since they do not address the endogeneity issues mentioned above.

[16] Buchmueller (2000) comments on studies estimating the direct costs of illnesses, as well as their indirect costs associated with lost productivity. However, he points to reasons why these studies are flawed and not useful for estimating productivity-enhanced benefits to employers offering insurance.

This paper contributes to the empirical literature on the relationship between employer-sponsored health insurance and productivity in a number of ways. First, we address the fact that the employer's decision to offer this benefit is not exogenous. Second, the data permit construction of a direct measure of labor productivity for manufacturers. In addition to all manufacturers, we look at the relationship between health insurance offers and productivity in small manufacturers.

3. Data

Unique data are used for our analysis and are created by matching two non-public use datasets. We use data from the 1997 and 2002 Census of Manufactures (CMF) linked to the 1997 and 2002 Medical Expenditure Panel Survey-Insurance Component (MEPS-IC). These two datasets are originally drawn from the Census Bureau's Business Register, which uses an establishment identification number that is included in both the CMF and MEPS-IC. This number allows us to do an exact match. In both the 1997 and 2002 matched sample, approximately 95 percent of manufacturing establishments in the MEPS-IC sample are matched to the CMF.

The MEPS-IC is a nationally representative survey of employers that is collected annually by the U.S. Census Bureau and sponsored by the Agency for Healthcare Research and Quality. While data are collected on employers in both the public and private sectors, we use data on the private employers. The MEPS-IC collects data on offers of health insurance to workers, as well as information about the establishments and their workforce. Health plan data include information on provider arrangements, premiums, contributions, and enrollments. Data on the establishments include establishment and firm size, ownership type, firm age, industry,

and location. Information collected on workforce characteristics includes the percent of workers that are women, 50 or more years of age, belong to a union, and earn low/medium/high wages. We use the MEPS-IC measures indicating insurance offers, firm age, firm size, and workforce characteristics for the analyses.

The CMF is conducted every 5 years (e.g., 1992, 1997, 2002) and covers about 380,000 manufacturing plants in the U.S. It contains plant-level data on revenue such as total value of shipments, value added, inputs including labor (such as total number of employees, production-worker hours), book value of capital (such as building and machinery), materials (materials and parts) and energy (electricity and fuels). The CMF also collect data on location (state, county, etc.), industry, and other plant characteristics such as belonging to a multi-unit or single-unit firm. It also collects data on salaries and wages and supplemental labor costs and inventories. We use data taken from the CMF to develop measures for revenue, inputs, and plant characteristics, required for our productivity analysis.

4. **Empirical models**

Our basic empirical model is the following conventional Cobb-Douglas production function, modified to estimate the relationship between plant labor productivity and employer-provided insurance. That is,

$$Log(R_{it}/L_{it}) = \alpha_0 + \alpha_1 INSURE + \alpha_2 Log(K_{it}/L_{it}) + \alpha_3 Log(M_{it}/L_{it}) + \alpha_4 (COMP\_MED)$$

$$+ \alpha_5 (COMP\_HIGH) + \alpha_6 PUNION + \alpha_7 PFEMALE + \alpha_8 PFIFTY$$

$$+ \Sigma \alpha_e SIZE_e + \alpha_9 MU + \Sigma \lambda_j INDUSTRY_j + \Sigma \gamma_m STATE_m + \varepsilon_{it} \qquad (1)$$

where subscripts *i* and *t* denote plant *i* and year *t*, respectively. *R/L* represents labor productivity and is defined as revenue per worker. We use the plant's total value of shipments as a proxy for gross revenue, *R*. Labor input, *L*, is measured by total number of employees of the plant.[17] The variable *INSURE* has a value of 1 if the plant offers health insurance; it equals zero otherwise.

K/L and *M/L* denote the capital (*K*)/labor ratio and the materials (*M*)/labor ratio, respectively. We use book value of the plant capital stock (including building and machinery) as a proxy for capital input, *K*.[18] Material input is the sum of values of materials and parts, value of energy consumed (including electricity and fuels), and values of contract work.

COMP_MED and *COMP_HIGH* are dummy variables proxying for whether the plant has medium or high labor quality respectively. Following Bahk and Gort (1993) we first calculate average compensation per hour[19,20], which is defined as:

$$COMP = (WW + OW + LC) / H \qquad (2)$$

[17] Revenue per hour is an alternative labor productivity measure that will also be tested by the authors. Using number of hours instead of number of workers would help identify whether the relationship between labor productivity and health insurance may be related to workers putting in more effort in the same number of hours or working more hours.

[18] Because data on capital input (i.e., capital services), K, are not available, we use book values of gross capital stocks (including buildings and machinery assets) collected in the CMF as a proxy. Book values are likely to be subject to measurement errors. First, the data reported in book values do not accurately reflect the value of capital. Second, using a simple sum of buildings and machinery assets as a proxy for K assumes that these components of capital are homogeneous. This assumption is obviously incorrect. Third, there is no adjustment for differences in the quality of capital. Fourth, there is no adjustment for intensity of use. Although we recognize these limitations, it is difficult to see how the problems could have been handled in the context of cross-sectional analysis. As a practical matter, we follow previous studies (e.g., McGuckin et al., 1998, and Greenan et al., 2001) and use book values of the capital as a proxy for K. This implies that services are proportional to book value of capital. This assumption appears to be reasonable given that we control for plant characteristics in our regressions.

[19] Bahk and Gort argue that "plants generally face a common labor market and that variations in average wages at a point in time, therefore, mainly measure differences in skills rather than differences in the prices of identical classes of labor" (p. 565).

[20] Skill measured by the ratio of the plant's non-production worker/total employment was also used as a proxy for labor quality. The results are generally consistent with the models using average compensation as a proxy for labor quality. The number of non-production workers, however, is thought to be an inferior measure for skill because it may include high-level managers as well as administrative support as non-production workers. This dilutes its usefulness as a measure of worker skill and the results are therefore not presented here.

where *COMP* refers to compensation, *WW* and *OW* denote total production worker wages and total salaries on non-production workers. *LC* measures total supplemental labor cost[21], which include legally required and voluntary supplemental labor costs.[22] *H* is labor input defined as "production-worker equivalent" work hours. This measure is calculated by dividing total salaries and wages by production-worker wage per hour. The distribution of this final plant-level average compensation measure is used to define categories and create dummy variables reflecting whether the plant has low (*COMP_LOW*), medium (*COMP_MED*), or high labor quality (*COMP_HIGH*).[23,24] Low average compensation is the omitted category. Additional controls for workforce characteristics that may affect labor productivity include percent of workers unionized (*PUNION),* female (*PFEMALE)*, and fifty years of age or older (*PFIFTY*).

As for the plant size variable (*SIZE)*, we use six dummy (0,1) variables: total employment less than 10, between 10 and 24, 25 and 99, 100 and 249, and 250 or more employees.[25] Less than 10 employees is the omitted category. The variable *MU* takes a value of 1 if the plant belongs to a multi-unit firm and zero if the plant is a single-unit firm. *INDUSTRY* is measured

[21] LC includes the cost of health insurance along with other benefits. The employer's cost for health insurance can be calculated using data from the MEPS-IC and deducted from the LC measure. The argument for this approach is not clear. Assuming workers of equal skill at plants offering or not offering insurance, workers would receive compensation packages of comparable cost to the employer whether or not they included health insurance benefits. Therefore, keeping the compensation costs as is (i.e., including health insurance plus wages or only wages) is preferred to lowering the compensations costs for the worker receiving health insurance for the purposes of the analyses here.

[22] Legally supplemental labor costs include the payments for all programs required under Federal and State legislation such as unemployment compensation and state temporary disability payments. Voluntary supplemental labor costs include the payments for programs that are not required by Federal or State legislation such as health and life insurance premiums, stock purchase plans and deferred profit sharing plans.

[23] Low, medium, and high labor quality is proxied by average compensation less than $15/hour, $15-20/hour, and $20/hour or more, respectively.

[24] Categorical measures for labor compensation are considered less problematic than a continuous measure with respect to potential endogeneity and therefore used in the model.

[25] In a Cobb-Douglas productivity function, the labor input variable L enters the equation both as a separate variable and as the denominator of the dependent variable, log(R/L) and right-side variables such as log(/K/L) and log(M/L). An estimated coefficient of L has value equal (less than or greater) than zero implies constant returns to scale (decreasing returns to scale or increasing returns to scale). However, since L enters as a denominator in both left and right side variable, running a regression with L as a separate variable would introduce bias in the parameter estimates if there is measurement error in L. Thus, we use dummy variable for size rather than a single continuous variable.

using 5-digit NAICS code to create dummy variables for industry. Including industry partly controls for differences in prices related to the quality of output. That is, higher quality output requires more complex processing and high quality workers. Finally, we use state dummies to capture geographic variation in productivity.

A key methodological issue is identifying productivity effects arising from unique aspects of health insurance from other factors causing a positive correlation between insurance and labor productivity. In other words, *INSURE* may be correlated with the error term, because the same factors that affect labor productivity may influence the plant's decision to offer health insurance. For example, plants may offer this benefit to compete in the labor market and attract and retain highly skilled workers who are more productive. We therefore estimate our model using a two-stage full maximum likelihood estimation method that produces Huber-White robust standard errors.[26,27] We first estimate the following probit regression:

$$INSURE = \beta_0 + \beta_1 HCC + \beta_3 (HCC)^2 + + \beta_4 (COMP\_MED) + \beta_5 (COMP\_HIGH)$$

$$+ \beta_6 PUNION + \beta_7 PFEMALE + \beta_8 PFIFTY$$

$$+ \Sigma\beta_s (FIRM\ SIZE)_s + \beta_9 MU + \Sigma\beta_a (FIRM\ AGE)_a + \Sigma\gamma_q STATE_q + \eta. \qquad (3)$$

The challenge is to find an instrumental variable affecting the offer of health insurance, but not expected to affect labor productivity at the plant. Since cost is often given by businesses as an issue with offering this employee benefit, county-level Medicare costs[28] are chosen as an

[26] For this point see Maddala (1983) and Greene (2000).

[27] The robust variance estimation procedure was developed by Huber (1967) and White (1980, 1982). Robust standard errors are produced using TREATREG procedure code in STATA, which considers the effect of an endogenously chosen binary treatment on another endogenous continuous variable, conditional on two sets of independent variables.

[28] We use Medicare Part A and B Aged Payment Rate from the Centers for Medicare and Medicaid Services *Adjusted Average Per Capita Cost (AAPCC) File*. The sum of the Part A and Part B rates, payment rates for hospital insurance and supplementary medical insurance, respectively for persons 65 and older are used. These

instrument and enter the model both linearly (*HCC)* and quadratically (HCC^2).[29] *A priori* we do not know if the relationship between these health care costs and insurance offers will be positive or negative. Higher costs may reflect greater demand for insurance resulting in a positive relationship, while higher costs resulting in higher premiums may result in fewer offers and a negative relationship. Because we do not anticipate these costs affecting productivity, they are only included in the first stage of the estimation. Using the parameter estimates of equation (3), we can construct an instrumental variable *Pr(INSURE*), the probability that a plant offers health insurance to its workers, to use in estimating equation (1).

Proxies for labor quality are again measured using categorical measures (*COMP_MED* and *COMP_HIGH*) to help reduce issues of endogeneity related to compensation in this offer equation. We also include controls for workforce characteristics because heterogeneity among workers may influence the employer's decision to offer insurance. Employers may wish to attract workers with particular characteristics, while workers with different characteristics may value insurance differently and have different demand for health insurance. Multi-unit status and plant location are as defined earlier. Firm size is included using dummy variables for the following categories: less than 10, 10-24, 25-99, 100-249, and 250 or more employees.[30] Firm age is also included using dummy variables indicating age less than 5, 5-9, 10-20, and 20 or more years. The omitted categories include firm size less than 10 employees and firm age less than 5 years.

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county-level data are contained in the Area Resource Files (ARF) collected by the U.S. Department of Health and Human Services and linked to the plants in the 1997 and 2002 MEPS-IC samples using location code.

[29] While it may be preferable to use health care costs from a previous year when predicting the plant's decision to offer insurance in 1997, the Medicare cost data is unavailable prior to 1997. Aside from availability, the high correlation between the costs from different years helps justify using costs from the same year. Pearson correlation coefficients for Medicare costs from 1997 and 1998 are 0.98 and from 1997 and 2002 are about 0.88.

[30] Ranges of firm size are used because the relationship between health insurance offers and firm size are not considered linear.

We conduct cross sectional analyses with these models using data from 1997 and 2002 for the entire matched sample, as well as on plants with fewer than 100 employees. All models are establishment-weighted. Estimates produced are therefore representative of the entire U.S. manufacturing sector.

5. Empirical results

Table 1 reports the simple means of the variables used in the 1997 and 2002 analyses.[31] 65 percent of the plants offered health insurance (*INSURE)* in 1997, while 70 percent offered the benefit in 2002. From the table, it is clear that establishments offering health insurance are more productive, have higher average compensation per hour, and more capital (*K/L)* and material (*M/L)* intensive than those providing no health insurance. The average percents for the establishment size categories also show that plants offering insurance are larger, which is expected.

In 1997, average labor productivity (*R/L*) in establishments offering health insurance is approximately two times larger than for those not offering health insurance. While in 2002, plants offering health insurance have average *R/L* about only 25 percent greater than plants not offering the benefit.[32] This is consistent with work by McCue and Zawacki (2006) that links the MEPS-IC with economic censuses from each industrial sector. They show that productivity is about 73 percent higher in plants offering insurance than in plants that did not offer this benefit.[33]

In both years, smaller percents of low average compensation per hour (*COMP_LOW)* and larger percents of high average compensation per hour (*COMP_HIGH)* are seen for

[31] Only approximate numbers are provided for the samples used in the current analyses and estimates have been rounded since final results are not ready to be released.
[32] One explanation may be that low productivity workers sort into establishments without health insurance.
[33] Unlike our study, McCue and Zawacki (2006) does not look at causality. Labor productivity in their study is defined as dollar sales or receipts per employee.

establishments offering insurance than for plants not offering insurance. Since average compensation per hour is a proxy for labor quality, these estimates suggest plants offering health insurance have a higher quality workforce than plants not offering the benefit.

Table 1 also provides the means for the workforce characteristics. In both 1997 and 2002, plants offering insurance are more likely to be unionized (*PUNION*). This is expected since unionized establishments tend to have more generous benefit offerings than non-unionized plants. In 1997, establishments offering insurance have an average percent female workforce (*PFEMALE)* about 5 percent lower than plants not offering insurance. Finally, plants offering insurance have a 5 percent and 10 percent lower average percent of older workers (*PFIFTY)* in 1997 and 2002, respectively.

Table 2 also reports averages for plants with fewer than 100 employees. As seen for the whole sample, labor productivity, size, capital and material intensity are greater in the plants offering health insurance. Smaller plants also have slightly lower labor productivity. Since labor productivity is measured as revenue per worker, lower labor productivity may actually reflect smaller plants having lower prices for their output than larger plants.

The above statistics suggest that employer-sponsored health insurance is positively related to productivity and size of establishments; however, conclusions should not be made based on these means because they do not control for other factors such as types of plant (multi vs. single-unit firms), location and industries. Small and young establishments have both lower measured productivity and lower rates of health insurance offerings compared to larger and older plants. Therefore, it is important to control for size and age when studying differences. For this reason, we turn to a regression analysis.

Our probit estimates reported in Table 3 show that Medicare payment rates (*HCC* and HCC^2) are a significant determinant of whether or not an establishment (or firm) decides to offer health insurance to their workers in both 1997 and 2002.[34,35] A drop in Medicare costs from the 75th to the 25th percentile[36] increases the probability of an offer by about 1.5 percent in both 1997 and 2002.[37]

The marginal effects for the quality of the plant's labor force proxied by labor costs (*COMP_MED* and *COMP_HIGH*) are positive and statistically significant in both 1997 and 2002. Table 3 also shows that an older workforce *(PFIFTY)* reduces the probability that a plant will offer health insurance. Unreported estimates for firm size and firm age indicate that relative to plants belonging to either smaller or younger firms, plants from larger or older firms are more likely to offer health insurance.

As discussed before, we can address the endogeneity problem associated with offering insurance using two-stage estimation. Table 4 reports maximum likelihood estimates for 1997 and 2002. The estimated coefficients show that offering health insurance is positively associated with plants' labor productivity in both 1997 and 2002.[38] The estimated coefficient for *Pr(INSURE*) is 0.234 in 1997 and 0.346 in 2002 and significant at the one percent level in both

[34] Jointly testing the linear and quadratic Medicare cost terms, however, resulted in insignificant chi-squared values of 4.08 in 1997 and 4.03 in 2002.

[35] Marginal effects are the changes in the probability for an infinitesimal change in each continuous independent variable using the formula $f(\bar{x}b)b_i$ and for a discrete change in each dummy variable.

[36] This equates to about a $150 decrease in costs per Medicare beneficiary in 1997, and a decrease of about $50 in 2002.

[37] Reductions in Medicare costs do not appear unrealistic given large variations in spending across states and lack of evidence that higher spending results in improved health outcomes (Wennberg et al. 2002).

[38] Some might argue that health care costs are not exogenous if labor productivity is a function of worker health and health status is a function of health care costs. Labor productivity, however, may also be related to health insurance through other factors such as reduced employee turnover, absenteeism, etc. In addition, variations in health care costs do not necessarily explain changes in health outcomes (Wennberg et al. 2002).

years.[39] The coefficients are larger and more significant on *COMP_HIGH* (0.148 in 1997 and 0.177 in 2002) than for *COMP_MED* (0.069 in 1997 and 0.068 in 2002), but both show that average compensation used as a proxy for labor quality has a positive relationship with labor quality. *K/L* and *M/L* are also positively associated with labor productivity. While the coefficients for workforce characteristics are positive but not significant in 2002, *PUNION* and *PFEMALE* are both negatively related to labor productivity in 1997. *MU* is positively associated with labor productivity in both years. This finding is consistent with previous studies using plant-level data (e.g., see Atrostic and Nguyen, 2005).

Tables 5 and 6 provide results from the two-stage estimates for plants with less than 100 employees.[40] They are quite comparable to the estimates from the whole matched sample. In the first stage for 1997 and 2002, Medicare costs are again significant predictors of the probability that a plant offers health insurance as shown in Table 5. If these costs drop from the 90th to the 10th percentile, a decrease in costs of about $160, the probability that the small plants will offer this benefit increases about 2.4 percent in 1997 and 3.7 percent in 2002.[41] Table 6 shows that offering insurance is again positively associated with labor productivity in small plants. *COMP_MED, COMP_HIGH, K/L,* and *M/L* are all positively and significantly related to labor productivity in both 1997 and 2002. While not significant in 2002, *PUNION* and *PFEMALE* are again negatively and significantly related to labor productivity.

[39] Because prices are imbedded in the labor productivity measure (i.e., revenue per worker), the positive relationship between health insurance offers (instrumented using *HCC*) and revenue per worker may be related to differences in location prices. We attempt to control for this by including covariates for location as well as industry and size.
[40] The models were also run on samples of businesses defined as small if they had fewer than 25 or 50 employees. Results from these analyses were generally comparable to those for employers with fewer than 100 employees.
[41] An increase of one standard deviation in Medicare costs results in a decreased probability of offers of about 20 percent and 38 percent in 1997 and 2002, respectively.

6. Discussion and Concluding Remarks

Using a unique data set, the preliminary analyses in this paper show that manufacturing plants offering insurance have greater labor productivity in the form of increased revenue per worker. These findings hold in 1997 and 2002 for all plants as well as small establishments. Unlike past studies, these results are based on models that control for the endogeneity of health insurance offers and use a direct measure of productivity.[42] Health insurance may improve productivity through a number of ways, by improving health status and work effort and/or by reducing absenteeism, worker turnover, and workmen's compensation.

Decision makers are currently struggling with the large number of uninsured as health care costs continue to rise. As in past decades, reliance on the employer-based system of private health insurance coverage continues. While economists and non-economists disagree on whether workers or employers pay for health insurance, this paper provides evidence suggesting businesses benefit from offering health insurance. Given that manufacturing represents only one sector of the economy, further work is needed to evaluate how employer offers of health insurance may impact productivity in other industries.

[42] We note, however, that it is difficult to distinguish between direct effects of health insurance (e.g., improved health, greater work effort) and unmeasured components of skill when drawing conclusions about the impact of health insurance on productivity.

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Table 1. Means of Variables*

Variables		1997 N=2,100 *Offer health insurance*	1997 N=2,100 *Do not offer health insurance*	1997 N=2,100 *Whole sample*	2002 N=2,400 *Offer health insurance*	2002 N=2,400 *Do not offer health insurance*	2002 N=2,400 *Whole sample*
Percent insure	*INSURE*	0.65	0.35		0.70	0.30	
Labor productivity	*R/L*	170	85	140	175	130	160
Establishment size							
Less than 10	*EST<10*	0.30	0.80	0.45	0.30	0.80	0.50
10 – 24	*EST10*	0.25	0.10	0.20	0.25	0.10	0.15
25 – 99	*EST25*	0.25	0.10	0.15	0.25	0.10	0.15
100 – 249	*EST100*	0.10	0	0.10	0.10	0	0.10
250+	*EST250*	0.10	0	0.10	0.10	0	0.10
Average compensation per hour							
Low	*COMP_LOW*	0.40	0.55	0.50	0.25	0.45	0.30
Medium	*COMP_MED*	0.35	0.35	0.35	0.35	0.30	0.35
High	*COMP_HIGH*	0.25	0.10	0.15	0.40	0.25	0.35
Multi-unit status	*MU*	0.25	0.10	0.15	0.25	0.15	0.20
Capital labor ratio	*K/L*	60	30	50	70	40	65
Material labor ratio	*M/L*	85	40	65	85	60	80
Percent workers unionized	*PUNION*	0.10	0	0.10	0.10	0	0.10
Percent workers female	*PFEMALE*	0.30	0.35	0.30	0.30	0.30	0.30
Percent workers 50+ years of age	*PFIFTY*	0.20	0.25	0.20	0.20	0.30	0.25

Note: Labor productivity, capital labor ratio and material labor ratio are in thousand dollars. Establishment size is the number of employees. Establishment-weighted estimates.

* Only approximations are provided because this research is still preliminary.

Table 2. Means of Variables: Plants with fewer than 100 employees*

		1997 N=1,500			2002 N=1,500		
Variables		*Offer health insurance*	*Do not offer health insurance*	*Whole sample*	*Offer health insurance*	*Do not offer health insurance*	*Whole sample*
Percent insure	*INSURE*	0.60	0.40		0.70	0.30	
Labor productivity	*R/L*	160	85	131	165	130	155
Establishment size							
Less than 10	*EST<10*	0.35	0.80	0.55	0.40	0.80	0.55
10 – 24	*EST10*	0.30	0.10	0.25	0.30	0.10	0.20
25 – 99	*EST25*	0.35	0.10	0.20	0.30	0.10	0.25
Average Compensation per hour							
Low	*COMP_LOW*	0.40	0.55	0.45	0.25	0.45	0.30
Medium	*COMP_MED*	0.40	0.35	0.35	0.35	0.30	0.35
High	*COMP_HIGH*	0.20	0.10	0.20	0.40	0.25	0.35
Multi-unit status	*MU*	0.20	0	0.10	0.20	0.10	0.15
Capital labor ratio	*K/L*	55	30	45	65	40	55
Material labor ratio	*M/L*	80	40	65	80	60	75
Percent workers unionized	*PUNION*	0.10	0	0.10	0.10	0	0.10
Percent workers female	*PFEMALE*	0.30	0.35	0.30	0.25	0.30	0.30
Percent workers							
50+ years of age	*PFIFTY*	0.20	0.25	0.20	0.20	0.30	0.25

Note: Labor productivity, capital labor ratio and material labor ratio are in thousand dollars. Establishment size is the number of employees.
* Only approximations are provided in this table because this research is still preliminary.

Table 3. Probit Regression : 1997 and 2002
Dependent Variable: Health Insurance (INSURE)
(z-statistics in parentheses)

Independent Variable	*1997*		*2002*	
	Probit coefficients	*dF/dx marginal effects*[a]	*Probit coefficients*	*dF/dx marginal effects*[a]
Intercept	-3.147** (-3.14)	-0.991** (-3.14)	-6.944* (-2.00)	-1.503* (-2.00)
HCC	**8.193*** **(2.01)**	**2.581*** **(2.01)**	**21.595+** **(1.89)**	4.675+ **(1.89)**
$(HCC)^2$	**-8.292*** **(-2.01)**	**-2.612*** **(-2.01)**	**-17.774+** **(-1.95)**	**-3.848+** **(-1.95)**
COMP_MED	0.405** (3.52)	0.122** (3.52)	0.761** (5.33)	0.144** (5.33)
COMP_HIGH	0.638** (3.86)	0.170** (3.86)	0.722** (5.18)	0.138** (5.18)
PUNION	0.616 (1.07)	0.194 (1.07)	-0.091 (-0.14)	-0.020 (-0.14)
PFEMALE	-0.217 (-1.24)	-0.068 (-1.24)	-0.243 (-1.16)	-0.053 (-1.16)
PFIFTY	-0.444* (-2.09)	-0.140* (-2.09)	-0.480* (-2.28)	-0.104* (-2.28)
MU	0.304 (1.16)	0.089 (1.16)	0.312 (0.90)	0.061 (0.90)
FIRM SIZE	Yes	Yes	Yes	Yes
FIRM AGE	Yes	Yes	Yes	Yes
STATE	Yes	Yes	Yes	Yes
Log Likelihood	-847	-847	-953	-953
N	2,100	2,100	2,400	2,400

[a] Marginal effects are the changes in the probability for an infinitesimal change in each continuous independent variable using the formula $f(\bar{x}b)b_i$ and for a discrete change in each dummy variable.

Notes:
(1) **, * and + denote "statistically significant" at the 1%, 5% and 10% levels, respectively.
(2) INSURE = 1 if health insurance is offered by the establishment, INSURE = 0, otherwise
(3) HCC and HCC^2=Linear and quadratic measures for health care costs proxied using county-level Medicare Part A and B from 1997 and 2002
(4) COMP_MED and COMP_HIGH=Dummy variables indicating average compensation per production-worker equivalent worked hour is medium or high. Used as a measure of labor quality. Low is the omitted category.
(5) PUNION, PFEMALE, PFIFTY=percent of workers unionized, female, 50+ years of age
(6) MU=dummy variable set to 1 if the plant is owned by a multi-unit firm, 0 otherwise
(7) FIRM SIZE: dummy variables representing 5 firm sizes: <10, 10-24, 25-99, 100-999, and 1000 or more employees; <10 employees is the omitted firm size variable
(8) FIRM AGE: dummy variables representing 4 firm ages: <5, 5-9, 10-20, and >=20 years; firm age <5 is the omitted category
(9) STATE=state fixed effects
(10) N = approximate sample size. Approximation given because research still in preliminary stage.

Table 4 . Health Insurance and Labor Productivity:
Two-Stage Maximum Likelihood Regressions, 1997 and 2002

Dependent Variable: Log(Labor productivity)
(z-statistics in parentheses)

Independent Variable	*1997*	*2002*
Intercept	1.848** (16.52)	2.389** (10.83)
Pr(INSURE)	**0.234**** **(4.70)**	**0.346**** **(5.63)**
COMP_MED	0.069* (2.56)	0.068* (2.36)
COMP_HIGH	0.148** (4.17)	0.177** (5.05)
Log(K/L)	0.103** (6.42)	0.116** (6.62)
Log(M/L)	0.567** (21.13)	0.438** (19.16
PUNION	-0.106* (-2.40)	0.073 (1.50)
PFEMALE	-0.163** (-4.73)	0.012 (0.22)
PFIFTY	-0.053 (-1.55)	-0.053 (-1.10)
MU	0.095** (2.81)	0.066+ (1.82)
PLANT SIZE	Yes	Yes
INDUSTRY	Yes	Yes
STATE	Yes	Yes
Wald χ^2	7.49**	17.42**
N	2,100	2,300

Notes:
(1) **, * and + denote "statistically significant" at the 1%, 5% and 10% levels, respectively.
(2) Log(Labor productivity) = Log of (plant's total value of shipments) / (plant's total number of employees)
(3) Pr(Insure) : the estimated probability that the plant offers health insurance.
(4) COMP_MED and COMP_HIGH=Dummy variables indicating average compensation per production-worker equivalent worked hour is medium or high. Used as a measure of labor quality. Low is the omitted category.
(5) PUNION=percent of workers unionized
(6) PFEMALE=percent of workers female
(7) PFIFTY=percent of workers 50 years of age or older
(8) MU=dummy variable set to 1 if the plant is owned by a multi-unit firm, 0 otherwise
(9) PLANT SIZE: dummy variables representing 5 plant sizes: <10, 10-24, 25-99, 100-999, and 1000 or more employees; <10 employees is the omitted plant size variable
(10) INDUSTRY = 5-digit NAICS industry code (dummy variables)
(11) STATE = Census code for states (dummy variables)
(12) N = approximate sample size. Approximation given because research still in preliminary stages.

Table 5. Probit Regression : 1997 and 2002 Plants with less than 100 employees
Dependent Variable: Health Insurance (INSURE)
(z-statistics in parentheses)

Independent Variable	*1997*		*2002*	
	Probit coefficients	*dF/dx [a] marginal effects*	*Probit coefficients*	*dF/dx [a] marginal effects*
Intercept	-3.207**	-1.147**	-6.821+	-2.290+
	(-3.19)	(-3.19)	(-1.95)	(-1.95)
HCC	**8.371***	**2.994***	**21.160+**	**7.103+**
	(2.06)	**(2.06)**	**(1.84)**	**(1.84)**
$(HCC)^2$	**-8.448***	**-3.022***	**-17.456+**	**-5.860+**
	(-2.05)	**(-2.05)**	**(-1.90)**	**(-1.90)**
COMP_MED	0.413**	0.143**	0.768**	0.235**
	(3.57)	(3.57)	(5.33)	(5.33)
COMP_HIGH	0.643**	0.202**	0.726**	0.221**
	(3.87)	(3.87)	(5.17)	(5.17)
PUNION	0.601	0.215	-0.087	-0.029
	(1.02)	(1.02)	(-0.13)	(-0.13)
PFEMALE	-0.215	-0.077	-0.247	-0.083
	(-1.21)	(-1.21)	(-1.17)	(-1.17)
PFIFTY	-0.448*	-0.160*	-0.483*	-0.162*
	(-2.10)	(-2.10)	(-2.29)	(-2.29)
MU	0.402	0.132	0.296	0.091
	(1.36)	(1.36)	(0.82)	(0.82)
FIRM SIZE	Yes	Yes	Yes	Yes
FIRM AGE	Yes	Yes	Yes	Yes
STATE	Yes	Yes	Yes	Yes
Log Likelihood	-663	-663	-603	-603
N	1,500	1,500	1,300	1,300

[a] Marginal effects are the changes in the probability for an infinitesimal change in each continuous independent variable using the formula $f(\bar{x}b)b_i$ and for a discrete change in each dummy variable.

Notes:
(1) **, * and + denote "statistically significant" at the 1%, 5% and 10% levels, respectively.
(2) Size less than 100 determined using plant size $\leq$ log(99)
(3) INSURE = 1 if health insurance is offered by the establishment, INSURE = 0, otherwise
(4) HCC and HCC^2=Linear and quadratic measures for health care costs proxied using county-level Medicare Part A and B from 1997 and 2002
(5) COMP_MED and COMP_HIGH=Dummy variables indicating average compensation per production-worker equivalent worked hour is medium or high. Used as a measure of labor quality. Low is the omitted category.
(6) PUNION, PFEMALE, PFIFTY=percent of workers unionized, female, 50+ years of age
(7) MU=dummy variable set to 1 if the plant is owned by a multi-unit firm, 0 otherwise
(8) FIRM SIZE: dummy variables representing 5 firm sizes: <10, 10-24, 25-99, 100-999, and 1000 or more employees; <10 employees is the omitted firm size variable
(9) FIRM AGE: dummy variables representing 4 firm ages: <5, 5-9, 10-20, and >=20 years; firm age <5 is the omitted category
(10) STATE=state fixed effects
(11) N = approximate sample size. Approximation given because research still in preliminary stage.

Table 6. Health Insurance and Labor Productivity:
Two-Stage Maximum Likelihood Regressions,
1997 and 2002 Plants with less than 100 employees

Dependent Variable: Log(Labor productivity)
(z-statistics in parentheses)

Independent Variable	*1997*	*2002*
Intercept	1.840**	2.443**
	(14.72)	(10.24)
Pr(INSURE)	**0.228****	**0.327****
	(4.39)	**(4.48)**
COMP_MED	0.069*	0.081*
	(2.28)	(2.48)
COMP_HIGH	0.146**	0.191**
	(3.57)	(4.83)
Log(K/L)	0.106**	0.118**
	(5.75)	(6.03)
Log(M/L)	0.566**	0.433**
	(18.22)	(17.25)
PUNION	-0.148*	0.104
	(-2.19)	(1.55)
PFEMALE	-0.175**	0.022
	(-4.80)	(0.37)
PFIFTY	-0.053	-0.047
	(-1.54)	(-0.93)
MU	0.101*	0.063
	(2.34)	(1.47)
PLANT SIZE	Yes	Yes
INDUSTRY	Yes	Yes
STATE	Yes	Yes
Wald χ^2	6.72**	11.01**
N	1,500	1,400

Notes:
(1) **, * and + denote "statistically significant" at the 1%, 5% and 10% levels, respectively.
(2) Log(Labor productivity) = Log of (plant's total value of shipments) / (plant's total number of employees)
(3) Pr(Insure) : the estimated probability that the plant offers health insurance.
(4) COMP_MED and COMP_HIGH=Dummy variables indicating average compensation per production-worker equivalent worked hour is medium or high. Used as a measure of labor quality. Low is the omitted category.
(5) PUNION=percent of workers unionized
(6) PFEMALE=percent of workers female
(7) PFIFTY=percent of workers 50 years of age or older
(8) MU=dummy variable set to 1 if the plant is owned by a multi-unit firm, 0 otherwise
(9) PLANT SIZE: dummy variables representing 5 plant sizes: <10, 10-24, 25-99, 100-999, and 1000 or more employees; <10 employees is the omitted plant size variable
(10) INDUSTRY = 5-digit NAICS industry code (dummy variables)
(11) STATE = Census code for states (dummy variables)
(12) N = approximate sample size. Approximation given because research still in preliminary stages.